

PATENT COOPERATION TREATY

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INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY
(Chapter II of the Patent Cooperation Treaty)

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference TS 1519 PCT	FOR FURTHER ACTION		See Form PCT/PEA/416
International application No. PCT/EP2004/050504	International filing date (day/month/year) 13.04.2004	Priority date (day/month/year) 15.04.2003	
International Patent Classification (IPC) or national classification and IPC C01B3/38, B01J8/06, B01J8/00, B01J8/04			
Applicant SHELL INTERNATIONALE RESEARCH MAATSCHAPPIJ B.V.			
<p>1. This report is the international preliminary examination report, established by this International Preliminary Examining Authority under Article 35 and transmitted to the applicant according to Article 36.</p> <p>2. This REPORT consists of a total of 6 sheets, including this cover sheet.</p> <p>3. This report is also accompanied by ANNEXES, comprising:</p> <p>a. <input type="checkbox"/> sent to the applicant and to the International Bureau) a total of sheets, as follows:</p> <p><input type="checkbox"/> sheets of the description, claims and/or drawings which have been amended and are the basis of this report and/or sheets containing rectifications authorized by this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions).</p> <p><input type="checkbox"/> sheets which supersede earlier sheets, but which this Authority considers contain an amendment that goes beyond the disclosure in the international application as filed, as indicated in item 4 of Box No. I and the Supplemental Box.</p> <p>b. <input type="checkbox"/> (sent to the International Bureau only) a total of (indicate type and number of electronic carrier(s)) , containing sequence listing and/or tables related thereto, in computer readable form only, as indicated in the Supplemental Box Relating to Sequence Listing (see Section 802 of the Administrative Instructions).</p>			
<p>4. This report contains indications relating to the following items:</p> <p><input checked="" type="checkbox"/> Box No. I Basis of the opinion</p> <p><input type="checkbox"/> Box No. II Priority</p> <p><input type="checkbox"/> Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability</p> <p><input type="checkbox"/> Box No. IV Lack of unity of invention</p> <p><input checked="" type="checkbox"/> Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement</p> <p><input type="checkbox"/> Box No. VI Certain documents cited</p> <p><input type="checkbox"/> Box No. VII Certain defects in the international application</p> <p><input type="checkbox"/> Box No. VIII Certain observations on the international application</p>			
Date of submission of the demand 21.01.2005		Date of completion of this report 28.06.2005	
Name and mailing address of the international preliminary examining authority:  European Patent Office - P.B. 5818 Patentlaan 2 NL-2280 HV Rijswijk - Pays Bas Tel. +31 70 340 - 2040 Tx: 31 651 epo nl Fax: +31 70 340 - 3016		Authorized Officer Van der Poel, W Telephone No. +31 70 340-3760	



**INTERNATIONAL PRELIMINARY REPORT
ON PATENTABILITY**

International application No.
PCT/EP2004/050504

Box No. I Basis of the report

1. With regard to the **language**, this report is based on the international application in the language in which it was filed, unless otherwise indicated under this item.
- ☐ This report is based on translations from the original language into the following language, which is the language of a translation furnished for the purposes of:
- ☐ international search (under Rules 12.3 and 23.1(b))
 - ☐ publication of the international application (under Rule 12.4)
 - ☐ international preliminary examination (under Rules 55.2 and/or 55.3)
2. With regard to the **elements*** of the international application, this report is based on *(replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report)*:

Description, Pages

1-19 as originally filed

Claims, Numbers

1-4 as originally filed

Drawings, Sheets

1/2-2/2 as originally filed

☐ a sequence listing and/or any related table(s) - see Supplemental Box Relating to Sequence Listing

3. ☐ The amendments have resulted in the cancellation of:
- ☐ the description, pages
 - ☐ the claims, Nos.
 - ☐ the drawings, sheets/figs
 - ☐ the sequence listing (*specify*):
 - ☐ any table(s) related to sequence listing (*specify*):
4. ☐ This report has been established as if (some of) the amendments annexed to this report and listed below had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).
- ☐ the description, pages
 - ☐ the claims, Nos.
 - ☐ the drawings, sheets/figs
 - ☐ the sequence listing (*specify*):
 - ☐ any table(s) related to sequence listing (*specify*):

* If item 4 applies, some or all of these sheets may be marked "superseded."

**INTERNATIONAL PRELIMINARY REPORT
ON PATENTABILITY**

International application No.
PCT/EP2004/050504

Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes: Claims	1-4
	No: Claims	
Inventive step (IS)	Yes: Claims	
	No: Claims	1-4
Industrial applicability (IA)	Yes: Claims	1-4
	No: Claims	

2. Citations and explanations (Rule 70.7):

see separate sheet

Re Item V

**Reasoned statement with regard to novelty, inventive step or industrial applicability;
citations and explanations supporting such statement**

Reference is made to the following documents:

D1: US-A-4650651 (Union Carbide)
D2: US-A-2002/0006970 (Battelle Memorial)
D3: WO-A-01/55027 (ICI)
D4: NL-A-8403144 (Stamicarbon BV)

1. The present application does not meet the criteria of Article 33(1) PCT, because the subject-matter of claim 1 does not involve an inventive step in the sense of Article 33(3) PCT.
 - 1.1. Document D1 discloses a process for the preparation of synthesis gas, in which a hydrocarbon is partially oxidised in a vertically oriented reactor. The process further comprises reacting a second stream of hydrocarbon in a primary tubular reforming reactor. The heat for this endothermic reaction is provided by the hot gases of the partial oxidation. The primary reformed gas is mixed in the upper part of the partial oxidation reactor. The partial oxidation is combined with a downstream catalyst bed to make it an autothermal reformer (see figure; column 5, line 52 - column 6, line 51). The steam to hydrocarbon ratio in the primary reformer is preferably from 2:1 to 4:1. The ratio is determined by the carbon formation on the catalyst (see column 8, line 47 - column 9, line 13).

Present claim 1 defines a steam to **carbon** ratio, whereas in D1 a steam to **hydrocarbon** ratio is mentioned. However, since in D1 methane is used, this ratio seems to be the same.

The only difference between claim 1 and document D1, therefore, lies in the steam to carbon ratio in the primary reformer: in claim 1 this ratio is below 1, whereas in D1 this ratio preferably lies between 2 and 4.

The effect arising from this difference seems to be the fact that a lot less steam has to be heated and that therefore the heat economy of the process is improved. The objective problem can therefore be formulated as how to improve the heat economy of the D1 process.

At the time of D1, one was forced to work at high steam-to-carbon ratios to avoid carbon formation. However since the publication of document D1 (filed 1983), there has been a lot of development in reforming catalysts. Many of those catalysts are have lower propensity to form carbon and therefore give the possibility to work at lower steam to carbon ratios (see for example D2 (see claims)). Furthermore, since the primary reformed product will be further reacted in the secondary reformer a complete conversion of the hydrocarbons is also not necessary.

The person skilled in the art will select a catalyst which is able to work at low steam to carbon ratios, because the use of less steam means that there is less steam to be heated, which greatly improves the efficiency of the process. The subject-matter of claim 1 does not involve an inventive step.

The applicant has provided arguments why the above-mentioned objection would not be valid.

First the applicant alleged that the objection was based on an *ex post facto* analysis of the prior art. However, the examiner believes this is not true. Following the problem and solution approach, the objective problem should be to improve the heat economy of the D1 process. As discussed above, it would appear to the examiner that in view of this problem the person skilled in the art would lower the steam-to-carbon ratio.

As a second argument, the applicant has pointed to the examples, especially to examples 1 and 3. These examples would show that when working according to the invention, one achieves much lower methane concentrations in the product. Indeed in example 3, much lower methane concentrations are obtained than in example 1. However, example 1 is not at all equivalent to D1. In fact, example 1 discloses the case without recycle of the reformed product, whereas example 3 has this recycle. The steam-to-carbon ratio is 0.75 for both examples. The comparison therefore

**INTERNATIONAL PRELIMINARY
REPORT ON PATENTABILITY
(SEPARATE SHEET)**

International application No.

PCT/EP2004/050504

shows the effect of the recycle and not of the difference with D1, namely the steam-to-carbon ratio.

The examiner, therefore, maintains that the subject-matter of claim 1 does not involve an inventive step.

- 1.2. It is noted that similar objections arise from documents D3 and D4, which disclose similar arrangements of autothermal reformer and tubular reformer.
2. The subject-matter of claims 2-4 also does not involve an inventive step. The features of these claims are either disclosed in D1 or are obvious modifications to the person skilled in the art.